

The Taxonomic Status of *Buccinanops* d'Orbigny, 1841 (Gastropoda: Nassariidae)

by

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Abstract. The radulae of *Buccinanops cochlidium* (Dillwyn, 1817) and *B. moniliferum* (Kiener, 1834) were observed for the first time using the scanning electron microscope. Radular, morphological, and reproductive characters of the genera *Bullia*, *Dorsanum*, and *Buccinanops* are compared. It is concluded that the South American species belong to the genus *Buccinanops*.

INTRODUCTION

Species of the genus *Buccinanops* d'Orbigny, 1841, have been considered as belonging to several different taxa in previous works. Table 1 shows the genera and subgenera to which these species have been assigned by previous authors.

Seven species are presently included in the genus *Buccinanops*, all of them endemic to South America (see Table 2). Members of *Buccinanops* live in soft bottomed, shallow waters of the intertidal or infralittoral zones. They generally live in dense groups, and most of the species are scavengers.

The aim of this paper is to reinstate *Buccinanops* to full generic status within the family Nassariidae. It was compared with *Bullia* Gray in GRIFFITH & PIDGEON, 1834, and with *Dorsanum* Gray, 1847, because they are similar in shell morphology. Radular, morphological, conchological, and reproductive features were used for this comparison.

MATERIALS AND METHODS

Radular studies were carried out on two species of *Buccinanops*: *B. cochlidium* from the localities detailed in Table 3, and *B. moniliferum* from Praia de Pereque (Guaruja, Sao Paulo, Brazil). The radulae of both species were treated following the method of SOLEM (1972) and observed under the SEM in the Museo de Ciencias Naturales, La Plata, Argentina (MLP). Specimens of all species of *Buccinanops* were also used from the malacological collection housed in the División Zoología Invertebrados (MLP).

RESULTS

Radula

Buccinanops cochlidium has a rachiglossan radula (Figures 4–6). The central tooth is multicuspidate with 5–11 cusps that increase in size towards the middle of the series. The rachidian base is strongly curved when compared to the other species of the genus.

The inner and outer cusps of the lateral teeth are hook-shaped. The first cusp may be bifid (Figure 4). The lateral teeth always have 1–3 intermediate cusps. Generally, the lateral teeth are symmetrical, but in some cases there is a peculiar asymmetry in the number and shape of cusps (Figure 4).

The number of cusps (5–11) in the rachidian teeth of *Buccinanops cochlidium* represents the main variation. In addition, one or two prominent central cusps were also observed. There is no relation between the number of cusps, age, and sex (see Table 3).

The radula of *Buccinanops moniliferum* is similar to that of *B. cochlidium* (Figures 1–3). The central tooth has 11 cusps that decrease in size towards the sides. The rachidian base is gently concave with sharp borders. A more conspicuous central cusp may be present. The lateral teeth have two hooked cusps with 1–4 intermediate cusps.

Operculum

Operculum morphology in all *Buccinanops* species is very uniform. The operculum is large, sub-oval, and smooth margined, and has a subterminal nucleus. The growth lines are well defined.

Table 1

Genera and subgenera in which South American species of *Buccinanops* were placed by previous authors.

Buccinanops	Bullia (Buccinanops)
COSSMANN (1901)	ADAMS & ADAMS (1853)
STREBEL (1906)	CHENU (1859)
PEILE (1937)	TRYON (1882)
CARCELLES & PARODIZ (1939)	THIELE (1929)
CARCELLES (1944, 1950)	CERNOHORSKY (1982)
CARCELLES & WILLIAMSON (1951)	ALLMON (1990)
BARATTINI & URETA (1960)	
KLAPPENBACH (1961)	Dorsanum
CASTELLANOS (1970)	COSSMANN (1901)
RIOS (1970, 1975)	CARCELLES & PARODIZ (1939)
SCARABINO (1977)	CARCELLES (1944)
CERNOHORSKY (1984)	BARATTINI & URETA (1960)
RIOS (1985)	CASTELLANOS (1970)
CALVO (1987)	RIOS (1970, 1975)
	SCARABINO (1977)
Buccinum	Buccinanops (Dorsanum)
DILLWYN (1817)	RIOS (1985) (only for <i>B. moniliferum</i>)
KING & BRODERIP (1832)	
KIENER (1834)	
D'ORBIGNY (1841)	
DESHAYES in DESHAYES & EDWARDS (1844)	
Bullia	
REEVE (1846–1847)	
PILSBRY (1897)	
IHERING (1907)	
CERNOHORSKY (1982)	
ABBOTT & DANCE (1983, 1986)	

Shell

In general, the shell is large and thick, with an oblique plait at the base and a carina behind the fasciole. It lacks ornamentation except for growth lines; however, some species have sharp tubercles on the subsutural shoulder of the last whorls (*Buccinanops moniliferum* (Kiener)), subsutural spiral lines (*B. uruguayense* (Pilsbry)), or axial ribs on the first three or four teleoconch whorls (*B. cochlidium* (Dillwyn)). The apex is large, short, and blunt.

Egg Capsules

The egg capsules of all known species of *Buccinanops* show the same morphological pattern (PENCHASZADEH, 1971a, b, 1973). The capsules are attached to the callus and adjacent area of the mother's shell by means of a short pedicle. More than 80 capsules are attached to several specimens of *B. cochlidium*. The capsules, which are oval, flattened, and clear, vary in size, form, and ornamentation according to the species.

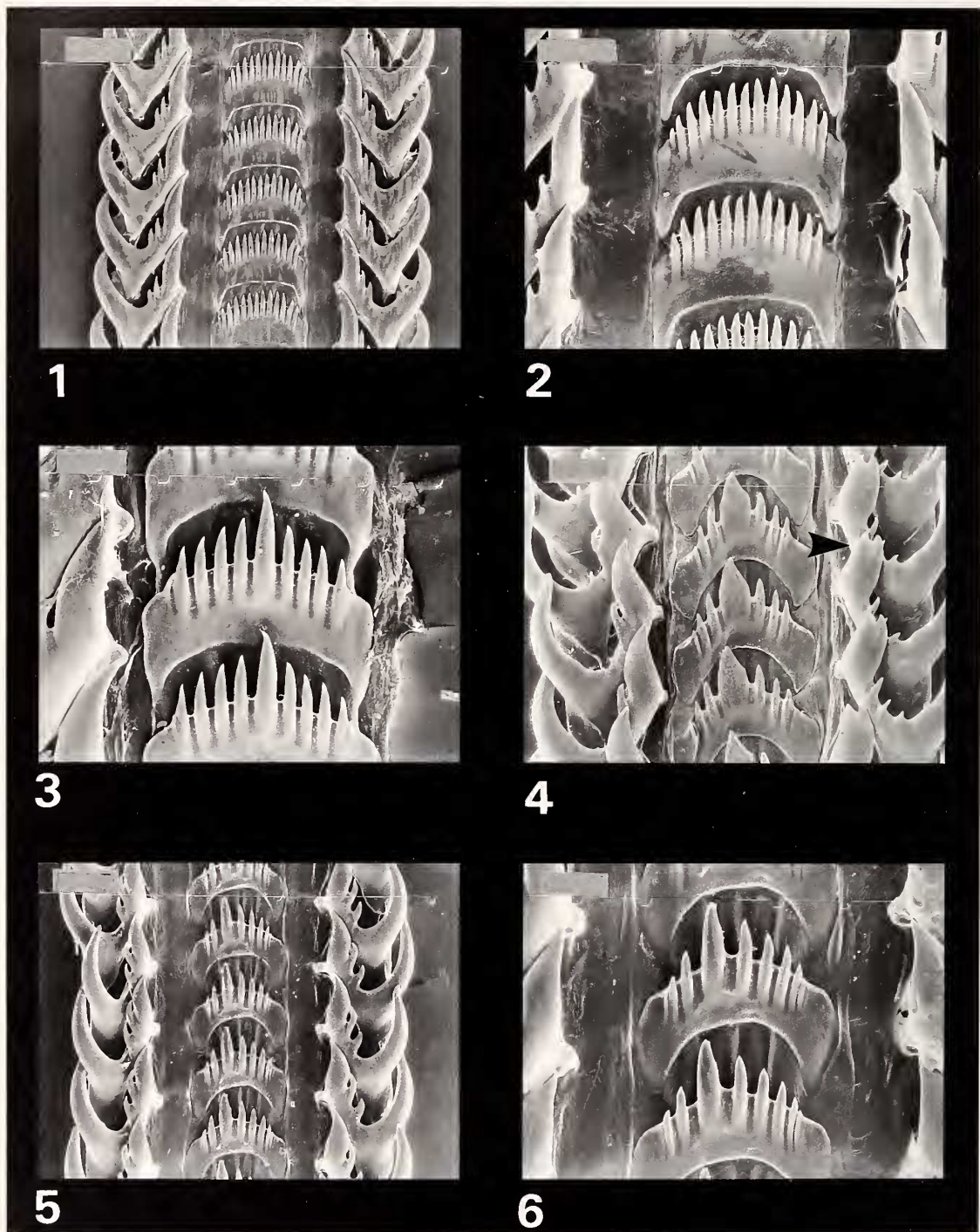
Table 2

Recent species of *Buccinanops* d'Orbigny, 1841. Institutional abbreviations: ZMC—Zoological Museum, Copenhagen, Denmark; BM—British Museum (Natural History), London, England; MHNG—Muséum d'Histoire Naturelle, Geneva, Switzerland; MN—Museo Nacional de Historia Natural, Montevideo, Uruguay; ANSP—Academy of Natural Sciences, Philadelphia, USA.

Species and author	Year	Type locality and repository
<i>B. cochlidium</i> (Dillwyn)*	1817	Islands of South Seas. ZMC
<i>B. deforme</i> (King & Broderip)	1832	Gorriti, Argentina. BM1985003
<i>B. moniliferum</i> (Kiener)	1834	Terra Nova [sic]. ?
<i>B. paytense</i> (Kiener)†	1834	Payta, Peru. ?
<i>B. globulosum</i> (Kiener)	1834	?. MHNG1296/17/1
<i>B. uruguayense</i> (Pilsbry)	1897	Maldonado Bay, Uruguay. ANSP70504
<i>B. duartei</i> Klappenbach	1961	La Coronilla, Uruguay. MN0709

* = *B. gradatum* (Deshayes in Deshayes & Edwards, 1844).

† = *B. squalidum* King & Broderip, 1832, non Gmelin, 1791.



Explanation of Figures 1 to 6

Figures 1–6. Genus *Buccinanops*. Scanning electron micrographs of radulae. Figure 1. *B. moniliferum*, general view; scale bar = 500 μm . Figure 2. Detail of rachidian teeth of the specimen in Figure 1; scale bar = 100 μm . Figure 3. *B. moniliferum*, detail of rachidian teeth; scale bar = 500 μm . Figure 4. *B. cochlidium*, arrowhead bifid cusps of the lateral tooth in asymmetric position; scale bar = 500 μm . Figure 5. *B. cochlidium*, general view; scale bar = 500 μm . Figure 6. *B. cochlidium*, detail of rachidian teeth; scale bar = 100 μm .

Table 3

Radular and opercular parameters of *Buccinanops cochlidium* (Dillwyn, 1817).

Shell length (mm)	Operculum length (mm)	Rachidian cusps	Lateral cusps	Sex	Locality
78	23.3	9	5	F	Pto. Piramide, Chubut
68.7	21.7	8	5	F	Pto. Piramide, Chubut
90.8	30	7	4	F	Pto. Piramide, Chubut
49	16.6	11	5-4	F	Pto. Piramide, Chubut
91	29	8	4	F	Rawson, Chubut
60.3	18.4	6	4	F	Rawson, Chubut
59.2	21.6	6	5-4	M	Rawson, Chubut
78.8	28.5	8	5	F	Mar del Plata, Buenos Aires
73.3	26	9	4	F	Mar del Plata, Buenos Aires
63.2	24.3	9	4	F	Mar del Plata, Buenos Aires
79.2	26	5	4	F	Mar del Plata, Buenos Aires
48.6	16	6	4	M	Pto. Piramide, Chubut
56	19	8	4	F	Pto. Piramide, Chubut
47	15.5	7	4	M	Pto. Piramide, Chubut
25.4	7.8	7	4	M	Pto. Piramide, Chubut
48.8	15.2	6	4	F	Pto. Piramide, Chubut
45.3	14.9	7	4	M	Pto. Piramide, Chubut
25	8.3	7	4	F	Pto. Piramide, Chubut
15.4	4.6	9	4	F	Pto. Piramide, Chubut

Larval Development

Buccinanops species with known larval development have one to nine embryos (*B. cochlidium*) that hatch in the crawling stage. However, each capsule may have up to 1600 nurse eggs (PENCHASZADEH, 1971a, b, 1973).

DISCUSSION

Despite minor specific differences among Recent species of *Buccinanops*, they form a very homogeneous group. In

contrast, the species of *Bullia* form a very heterogeneous one (ALLMON, 1990). *Dorsanum*, represented today only by *D. miran* (Bruguère) (*sensu* ALLMON, 1990), shows a very different set of features. Table 4 shows characteristic features of the three genera.

The radulae characteristic of the three genera differ. According to PEILE (1937), ADAM & KNUDSEN (1985), CALVO (1987), CERNOHORSKY (1984), and ALLMON (1990), rachidian teeth in *Bullia* and *Buccinanops* have similar morphology. *Buccinanops*, however, presents cusps that

Table 4

Comparison of generic features among *Buccinanops*, *Dorsanum*, and *Bullia*.

	<i>Buccinanops</i>	<i>Dorsanum</i>	<i>Bullia</i>
Shell	Large, with the base of the columella with one oblique plait; large and blunt apex	Medium to small size siphonal channel bordered by two spiral ridges; small and multispiral apex	Medium to small size, more slender; without periostracum; acute apex
Animal	Very large, with one posterior metapodial tentacle, without eyes, long cephalic tentacles	Medium in size without posterior metapodial tentacles, with eyes, short cephalic tentacles	Very large, with two posterior metapodial tentacles, without eyes, long cephalic tentacles
Operculum	Large, always without serrations, subterminal nucleus	Small, with smooth margins	Small, some with marginal serrations
Larval development	Young hatch as crawling veliger, only 1-9 eggs develop, others used as nurse eggs	Young hatch as pelagic veligers, all eggs develop	Same as <i>Buccinanops</i> or ovoviviparous
Egg capsule	Attached to the callous region of the female shell by means of a short pedicle	Always attached to the substrate	Some with filaments retained within the fold of the female's foot or buried below sand surface
Radula	Central tooth with cusps increasing in size towards the center	Central tooth with cusps of the same size, lateral teeth always bicuspidate	Central tooth with cusps of the same size or subequal

decrease in size towards the sides, with one or two central prominent cusps (Figures 4-6). *Bullia* shows rachidian cusps of the same or sub-equal size. *Dorsanum*, too, has similar rachidian teeth, although the cusps are smaller than in the other genera and they are all the same size.

The lateral teeth in *Bullia* show a great variety in number and morphology. Usually they have one or two intermediate cusps. *Buccinanops* always presents more than one intermediate cusp, up to three in the observed specimens. *Dorsanum* always has a bicuspidate lateral tooth.

Buccinanops and *Bullia* bear a carina posterior to the fasciole and a pronounced terminal columellar fold (CERNOHORSKY, 1984; ALLMON, 1990). *Dorsanum*, in contrast, has two oblique spiral carinae bounding a reflexed siphonal channel around the anterior end of the fasciole. These features definitely set *Dorsanum* apart from the other two genera. The shell apices of *Bullia* and *Dorsanum* are more acute and slender than those of *Buccinanops* (according to ALLMON, 1990:plates 5, 6).

Representatives of *Buccinanops* from studied localities are blind, have a well developed foot with one metapodial tentacle, and have large cephalic tentacles. *Bullia* is blind also, has two metapodial tentacles, and has long and slender cephalic tentacles (ALLMON, 1990). Once again, *Dorsanum* differs significantly from the other two genera: it has true eyes, no metapodial tentacles, and short cephalic tentacles (ADAM & KNUDSEN, 1985).

Opercula in *Buccinanops cochlidium* (Table 3), as in other species of the genus, are generally large with smooth margins. They vary little within the genus but differ greatly from those of the other genera. In *Bullia* the operculum is always small, but may be serrated or smooth margined. In *Dorsanum* the operculum is small and smooth margined.

Larval development in *Bullia* and *Buccinanops* shows several similarities, such as nurse eggs, non-planktonic larvae, and young that hatch as crawling veligers. However, the egg capsules are very different. The egg capsules in most species of *Bullia* are carried on the ventral surface of the maternal foot (ALLMON, 1990); the egg capsules are oval, thin, and transparent with two threads at either end. In contrast to the situation in *Bullia* and *Buccinanops*, *Dorsanum* has egg capsules attached to the substrate, pelagic veligers, and no nurse eggs.

ALLMON (1990) considered *Buccinanops* to be a sub-genus of *Bullia* on the basis of three factors: (1) The ranges of their conchological variations overlap; (2) They have non-planktonic larval development and are blind; and (3) *Bullia*, from South Africa and India, was judged to be the direct descendant of *Buccinanops* from South America. The first two factors are correct, although when compared to all the distinguishing features discussed in this paper there is supporting evidence to consider these genera as being distinct. Furthermore, the geographic distributions of *Bullia* and *Buccinanops* suggest two isolated lines of evolution. The idea of South African and Indian *Bullia* deriving from a South American ancestral stock of *Buccinanops* is prob-

ably correct, but that fact is an insufficient reason to subordinate *Buccinanops* to *Bullia*.

According to many characters, having to do with the radula, shell, developmental mode, egg capsule, operculum, and distribution, all the species of *Buccinanops* form an homogeneous group that differs substantially from the species of *Bullia*. Considering all of these, I suggest that *Buccinanops* be accorded full generic status.

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